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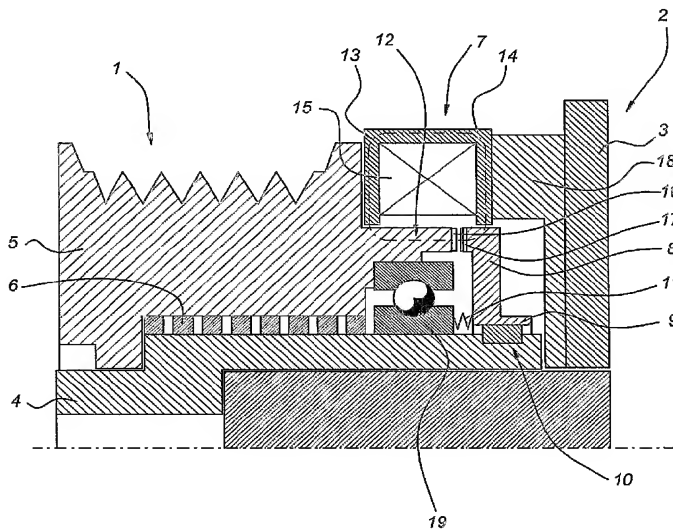
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(54) Title: CLUTCH DEVICE AND STARTER/GENERATOR COMPRISING SUCH CLUTCH DEVICE



(57) Abstract: A pulley device comprises a shaft (4), a pulley (5) which is rotatably mounted on said shaft, and a one-way clutch (6) for providing a freely rotatable condition when the shaft and the pulley are rotated with respect to each other in a first relative rotational direction, and for providing a fixation between the shaft and the pulley when they are rotated with respect to each other in the opposite relative rotational direction. A locking clutch (7) provides a fixation between the shaft and the pulley, said locking clutch preventing mutual rotations between the shaft and the pulley in both relative rotational directions.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Clutch device and starter/generator comprising such clutch device

The invention is related to a clutch device, comprising a shaft, a rotation member, such as a pulley, which is coaxially mounted on said shaft, and a one-way clutch for
5 providing a freely rotatable condition when the shaft and the rotation member are rotated with respect to each other in a first relative rotational direction, and for providing a fixation between the shaft and the rotation member when they are rotated with respect to each other in the opposite relative rotational direction.

Such a clutch device is known. It is applied in several fields, for instance in
10 connection with a generator for an internal combustion engine. In case the generator is coupled to the engine through a belt drive, variations in the engine torque cause belt vibrations and hence a reduction in belt life. As a result of the one-way clutch in the clutch device however, the transmission of vibrations from the engine, e.g. due to engine acyclism, is reduced. The reverse torque resulting from such phenomena is
15 limited, which has a favourable effect on belt behaviour.

The prior art device however has the disadvantage that it cannot be applied in combination with a combined starter and generator. The one-way clutch in fact prevents to transmit the starter torque to the engine, as it allows a free relative rotation in the drive direction of the starter. The object of the invention is therefore to provide a
20 clutch device which can also be applied in connection with a combined starter and generator.

Said object is achieved by a means of a locking clutch for providing a fixation between the shaft and the rotation member, said locking clutch preventing mutual rotations between the shaft and the pulley in both relative rotational directions. For
25 engine starting the locking clutch is engaged, effectively disabling the one-way clutch, allowing torque to be transmitted from the starter/generator device acting as a starter to the engine. Once the engine is started, said locking clutch can be disengaged, which then enables operation of the one way clutch, allowing the transmission of torque from the engine to the starter/generator device now acting as generator, but preventing the
30 transmission of torque from the starter/generator device to the engine, thereby preventing belt vibration due to engine acyclism.

Preferably, the locking clutch is of an electromagnetic type. The locking clutch may comprise a first armature which is axially slidably and rotationally fixed to the

shaft or the rotation member, and a second armature which is fixedly connected to the other of said shaft and rotation member. The coupling means of these said armatures may be provided by either friction plates or meshing teeth.

According to a particular embodiment, the clutch device comprises a locking
5 clutch for providing a fixation between the shaft and the rotation member, said locking clutch, when engaged, enabling direct torque transmission from the shaft to the rotation member, the one-way clutch being disabled.

The invention is furthermore related a belt driven starter/generator device,
comprising a starter/generator provided with a housing, a stator connected to the
10 housing, and a rotor having a rotor shaft rotatably supported with respect to the housing, as well as a clutch device as described before, said clutch device comprising a rotation member which is rotatably mounted on the rotor shaft, and a one-way clutch for providing a freely rotatable condition when the rotor shaft and the rotation member are rotated with respect to each other in a first relative rotational direction, and for
15 providing a fixation between the rotor shaft and the rotation member when they are rotated with respect to each other in the opposite relative rotational direction, as well as a locking clutch for providing a fixation between the rotor shaft and the rotation member, said locking clutch preventing mutual rotations between the rotor shaft and the rotation member in both relative rotational directions.

20 Said locking clutch comprises a first armature which is axially slidably and rotationally fixed to the shaft or the rotation member, a second armature which is fixedly connected to the other of said shaft and rotation member, an electromagnetic coil connected to the housing for generating a electromagnetic flux under the influence of which the armatures are attracted towards each other as well as coupling means
25 associated with said armatures, said coupling means engaging each other when the electromagnetic coil is energized.

The rotation member at its side facing the housing carries the second armature, and the electromagnetic coil extending next to said second armature. The electromagnetic coil is comprised of a flux carrying stator that may be U-shaped in
30 radial cross-section, and a radially wound electromagnetic magnetic coil extending into the recess defined by the U-shaped stator.

Furthermore, the first armature and the connecting bridge of the second armature have facing surfaces which may be provided with friction plates or meshing teeth.

The invention will now be described further with reference to an example of a clutch device according to the invention.

The figure shows a clutch device 1 in combination with a starter/generator device 2 only the front cap 3 of which is shown. The clutch device comprises a shaft 4 and a pulley 5 which is rotatable with respect to the shaft 4 in one direction only. This rotation between the shaft 4 and the pulley 5 is obtained by means of the one-way clutch 6 which in the present embodiment is carried out as a wrap spring. Other one-way clutches, such as with spragues, are possible as well. A bearing 19 is used to support the pulley on the shaft and allow rotation as dictated by the operation of the one-way clutch.

The starter/generator device shaft, which is not shown, is to be connected to the shaft 4 of the clutch device 1. For engine starting, torque must be transferred from the starter/generator device to engine. Since the one-way clutch 6 does not pass torque from starter/generator device to the engine, it must be temporarily locked-out to enable engine starting. This temporary lock-out is achieved by enabling the electromagnetic locking clutch 7 so that shaft 4 and pulley 5 are locked with no relative motion between them. Starting torque can then be transferred from the pulley 5 via the belt (not shown) to the internal combustion engine in question. This means that during the brief starting period there may be belt tension reversals.

The locking clutch 7 comprises a first armature 8 which is fixed on a sleeve 9. The sleeve 9 is axially slidable but non-rotatably fixed to the shaft 4 by means of the key/groove connection 10. A second armature 12 is fixedly connected to the pulley 1. Furthermore, the locking clutch comprises an electromagnetic actuator having a U-shaped stator 13 fixed through a bracket 18 to the front cap 3, as well as a coil 15 which fits within the recess of said stator 13. When the electromagnetic coil is energized a flux path 14 is created causing the first armature 8 together with sleeve 9 to be attracted towards the second armature 12. The facing surfaces 16 respectively 17 of the first armature 8 and the second armature 12 are provided with coupling means, for example friction plates or engaging teeth and as a result the pulley 5 is rigidly fixed to the shaft 4.

Once the internal combustion engine is started, the coil is de-energized and the first armature 8 is pushed out of contact with second armature 12 by a spring 11. The one-way clutch is thereby enabled and the starter/generator device now operates as a

generator. In this mode, the shaft 4 through the one-way clutch 6 rotates the pulley 5. The pulley 5 is connected to the internal combustion engine in question via a belt (not shown). The one-way clutch allows torque to pass from engine to starter/generator device, but does not let torque pass from starter/generator device to engine. In this way
5 the one-way clutch operates in generator mode to eliminate belt tension reversals and improve belt life. Although the rotation member has been described as a pulley, other embodiments are possible as well such as a tooth gear or a toothed belt gear.

Claims

1. Clutch device (1), comprising a shaft (4), a rotation member, such as a pulley (5), which is coaxially mounted on said shaft (4), and a one-way clutch (6) for
5 providing a freely rotatable condition when the shaft (4) and the rotation member (5) are rotated with respect to each other in a first relative rotational direction, and for providing a fixation between the shaft (4) and the rotation member (5) when they are rotated with respect to each other in the opposite relative rotational direction,
10 characterized by a locking clutch (7) for providing a fixation between the shaft (4) and the rotation member (5), said locking clutch (7) preventing mutual rotations between the shaft (4) and the rotation member (5) in both relative rotational directions.

2. Clutch device according to claim 1, wherein the one-way clutch (6) comprises a wrap spring.
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3. Clutch device according to claim 1, wherein the one-way clutch (6) comprises a series of spragues.

4. Clutch device according to claim 1, wherein the one-way clutch (6) comprises a one way clutch bearing comprising locking rollers.
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5. Clutch device according to any of the preceding claims, wherein the locking clutch (7) is of an electromagnetic type.

25 6. Clutch device according to claim 5, wherein the locking clutch (7) comprises a first armature (8) which is axially slidably and rotationally fixed to the shaft (4) or the rotation member (5), and a second armature (12) which is fixedly connected to the other of said shaft (4) and rotation member (5), as well as friction means associated with said armatures (8, 12), said friction means frictionally engaging each other when
30 the locking clutch (7) is energized.

7. Clutch device, comprising a shaft (4), a rotation member, such as a pulley (5), which is rotatably mounted on said shaft (4) and a one-way clutch (6) for providing a

freely rotatable condition when the shaft (4) and the rotation member (5) are rotated with respect to each other in a first relative rotational direction, and for providing a fixation between the shaft (4) and the rotation member (5) when they are rotated with respect to each other in the opposite relative rotational direction, characterized by a locking clutch (7) for providing a fixation between the shaft (4) and the rotation member (1), said locking clutch (7), when engaged, enabling direct torque transmission from the shaft (4) to the rotation member (5), the one-way clutch (6) being disabled.

8. Belt driven starter/generator device, comprising a starter/generator (2) provided with a housing (3), a stator (13) with coil (15) connected to the housing (3), and a rotor having a rotor shaft rotatably supported with respect to the housing (3), as well as a clutch device (1) according to any of the preceding claims, said clutch device comprising a rotation member (5), such as a pulley, which is rotatably mounted on the rotor shaft (4), and a one-way clutch (6) for providing a freely rotatable condition when the rotor shaft (4) and the rotation member (5) are rotated with respect to each other in a first relative rotational direction, and for providing a fixation between the rotor shaft (4) and the rotation member (5) when they are rotated with respect to each other in the opposite relative rotational direction, as well as a locking clutch (7) for providing a fixation between the rotor shaft (4) and the rotation member (5), said locking clutch (7) preventing mutual rotations between the rotor shaft (4) and the rotation member (5) in both relative rotational directions.

9. Starter/generator according to claim 8, wherein the locking clutch (7) comprises a first armature (8) which is axially slidably and rotationally fixed to the shaft (4) or the rotation member (1), a second armature (12) which is fixedly connected to the other of said shaft (4) and rotation member (5), an electromagnetic coil (18) connected to the housing (3) for generating an electromagnetic flux under the influence of which the armatures (8, 12) are attracted towards each other as well as coupling means (16, 17) associated with said armatures (8, 12), said coupling means engaging each other when the electromagnetic coil (18) is energized.

10. Starter/generator according to claim 9, wherein the rotation member (5) at its side facing the housing (3) carries the second armature (12), and the magnetic coil (18) extending next to said second armature (12).

5 11. Starter/generator according to claim 10, wherein the second armature (12) is an electromagnetic stator which is U-shaped in a radial cross-section, the electromagnetic coil (18) extending into the recess (20) defined by the U-shaped second armature (12).

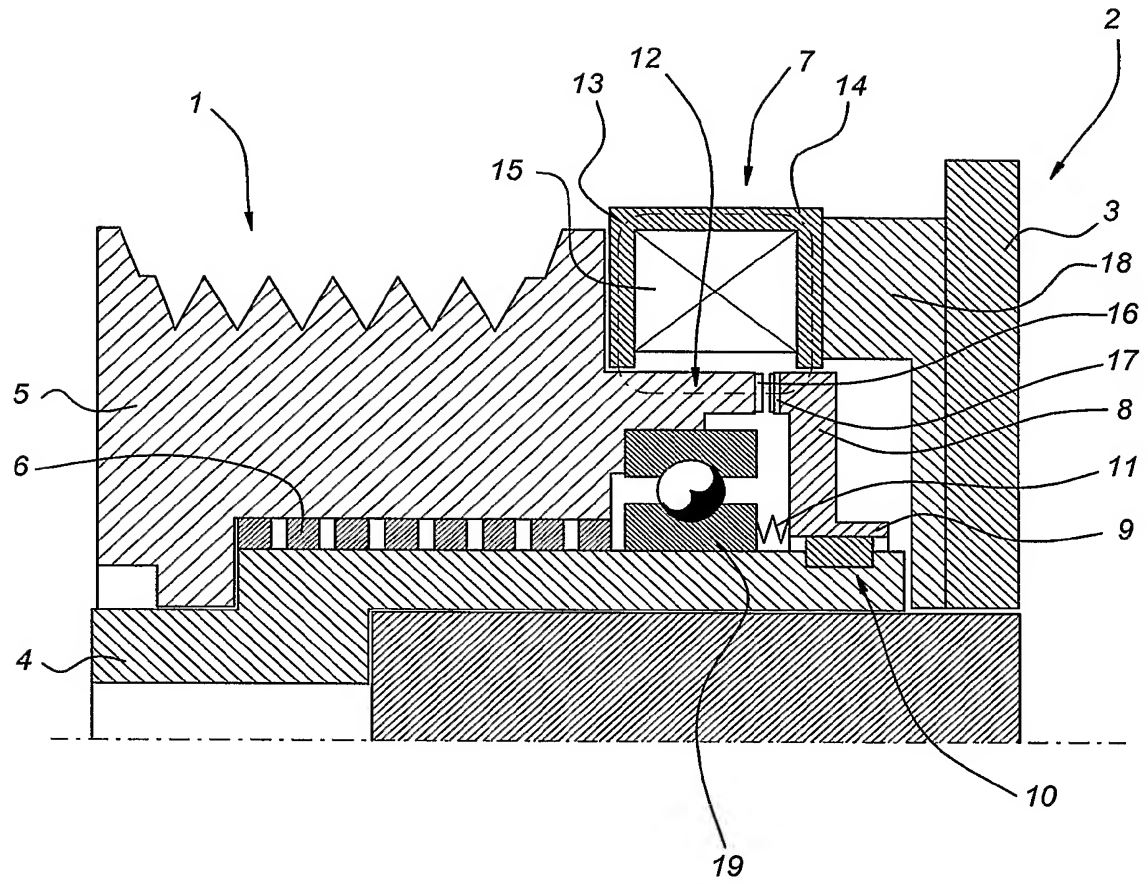
10 12. Starter/generator according to any of claims 8-11, wherein the shaft (4) carries an axially displaceable sleeve (9) onto which the first armature (8) is mounted.

13. Starter/generator according to claim 12, wherein the first armature (8) is ring shaped and extends radially outwardly with respect to the sleeve (9).

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14. Starter/generator according to any of claims 9-13, wherein the first armature (8) and the second armature (12) have facing surfaces (16, 17), said facing surfaces (16, 17) being provided with friction means or with teeth.

20 15. Starter/generator device according to any of claims 9-14, wherein biasing means (11) are provided for constantly urging the armatures (8, 12) away from each other.



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 2002/117860 A1 (REIK WOLFGANG ET AL) 29 August 2002 (2002-08-29) paragraph '0013! paragraph '0018! paragraph '0087! - paragraph '0092!; figures 1A,3	1,5,6,8, 9,14
Y	US 4 020 935 A (MORTENSEN HAROLD RICHARD) 3 May 1977 (1977-05-03) column 2, line 45 -column 3, line 7; figure 1	1,5,6,8, 9,14
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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